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## ABSTRACT

Papers are presented from the 1975 Society for Research into Higher Education European Symposium on Interdisciplinary (ID) Courses in European Education. Section one of the symposium on "philosophy and background" consists of an introduction by Professor Berger and discussion. Section two on "some ID courses" consists of the following papers: "The Structure of the Four-Year Degree Courses at Keele," by D. G. Holloway; "Interdisciplinarity in the Environmental Sciences," by J. G. Harvey; and "The School for Independent Study at N. E. London Polytechnic," by D. H. Robbins. Section three on "planning and administration of ID courses" includes "The Administration of Interdisciplinary Courses," by Z. C. Szkopiak and "Development of an Interdisciplinary Course at the University of Nijmegen," by J. F. M. C. Aarts and C. J. A. M. van der Linden. Section four on "research and development" includes "The SISCON Project: A Personal View of an Interdisciplinary Experiment," by David Edge; "Operational Research, Interdisciplinarity and Higher Education," by D. A. Conway; and "Methodological Issues in Evaluating Interdisciplinary Studies," by Rolf Schulmeister. Each section includes reports of a discussion group. (SW)

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# INTERDISCIPLINARITY

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# **Interdisciplinarity**

papers presented at the  
SRHE European Symposium  
on Interdisciplinary Courses in  
European Education  
13 September 1975

Society for Research into Higher Education Ltd  
at the University of Surrey, Guildford, Surrey, GU2 6HX  
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## PREFACE

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The second SRHE European Symposium, on Interdisciplinary Courses in European Education, was held at the City University, London, in September 1975. Once again the Society was greatly aided by a financial contribution from the Council of Europe, which helped to offset the travel and subsistence expenses of younger research workers from member states. In addition, the British Council assisted with the travel costs of some of the overseas participants.

In view of the interest shown in the topic of interdisciplinarity by the Centre for Educational Research and Innovation (CERI) of the Organisation for Economic Co-operation and Development (OECD), it was felt highly desirable for the introduction to the Symposium to be given by a speaker from CERI. The SRHE is most grateful to OECD for enabling Professor Guy Berger to attend and give the opening address.

The Symposium consisted of four sessions, to which the four sections of the present publication correspond. The chairmen were: Colin Flood Page (Session I); Frank Gould (Session II); Leo F. Evans (Session III); and Rector Bent Jorgensen (Session IV).

The Society would like to thank Colin Flood Page for preparing a transcript of the meeting and an edited version of the discussions as the basis of this report.

Michael N. Kendall  
Secretary, International Contacts Committee, SRHE

July 1977

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**SECTION I**

**Philosophy and Background**

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## INTRODUCTION

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by Professor Berger (University of Paris, VIII, Vincennes)

The Organisation for Economic Co-operation and Development (OECD) and more particularly the Centre for Educational Research and Innovation (CERI) have asked me to represent them at this symposium. If CERI has placed this matter in my hands it is because I have done some research in the domain of higher education, and principally because of my participation as consultant on this subject at the 1970 Nice Seminar on Interdisciplinarity; also because I was part of the working group which published a book on the seminar.

I want to describe part of the research undertaken by OECD and to indicate accurately the position of the Administration of CERI; but please bear in mind that I cannot promulgate an official position which as a matter of fact does not exist, and I will allow myself to make some personal comments and remarks as I proceed. My report will be principally a historical report, and I will sum up the conclusions that we have been able to voice following CERI's programme of Interdisciplinarity in Higher Education.

Following an inquiry on interdisciplinarity teaching and research experiments, which concerned at least seventy-two universities and twelve countries, and following the debates of the Nice symposium, the working group recruited by CERI to draft the book previously cited was able to make a few statements:

1. The idea of interdisciplinarity was a very good one. It filled a need felt by students, teachers and researchers in higher education. Fascinating experiments had taken place in a number of institutions, but the participants had difficulty in contacting and communicating with each other. For all those who had answered the questionnaire and for most of the participants at the seminar one was able to note the realisation of the clear link between the transformation of teaching methods, the attempts to solve the university crisis—particularly acute in 1970—and finally the condition of the development of modern science.
2. By interdisciplinarity people understood very different and sometimes contradictory activities. In particular the degree of co-operation between disciplines may have led to the supposition of total integration within a new and more complex discipline.

The CERI working group proposed the following terminology and definitions:

1. Multidisciplinarity is a grouping of various disciplines sometimes without apparent inter-connection.

#### 4 Interdisciplinarity

2. Pluridisciplinarity is a grouping of disciplines assumed to be more or less related, for example, mathematics and physics, or French, Latin and Greek, Classical Humanities, etc.
3. Interdisciplinarity is a close interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data, and organisation of research and education in a fairly large field.
4. Transdisciplinarity establishes a common system of axioms for a set of disciplines; and we proposed as an example anthropology considered as a science of man and his accomplishments according to L'Enfant's definition.

We have since dropped the word multidisciplinary because of a lack of specificity, and above all because it implied a dangerous dichotomy between disciplines with no apparent connection and disciplines assumed to be more or less related. On the other hand it seemed to us that pluridisciplinarity, interdisciplinarity and transdisciplinarity are words that are not debased by common usage. They are not defined in any sharply divided fashion, but correspond to degrees of interaction between disciplines. Within traditionally pluridisciplinary areas such as medicine they have allowed us to distinguish between what was mere juxtaposition of knowledge and what really described a complementary approach to the same object or the same situation.

Finally, if only for strategic reasons, it was important for us that interdisciplinarity should be set well apart from a number of more or less imperialist attempts at reducing traditionally distant disciplines to a kind of science of science, imposing its model, its concepts and its methodology. As early as the preparatory meetings for the Nice seminar it became clear that as interdisciplinarity was developing we were dealing with complex new fields of knowledge whose varied aspects could not be covered by any specific methodology and of which no existing discipline could claim to be the exclusive owner. In other instances interdisciplinarity gained from the fact that a subject was new (for example biochemistry), or from the fact that a subject had only recently been introduced into universities (for example, in France, Art and Management were immediately interdisciplinary in teaching). Lastly, there was a need for an interdisciplinary approach which seemed to go along with conceptual change in an otherwise traditional field: for instance, when one goes from the concept of curative medical sciences to the science of health and prevention. Consequently it was through various examples drawn from the field of health that we were able to observe *in vivo* the progressive passage from an extended pluridisciplinarity to real interdisciplinarity. We shall come back to this problem later.

Our next observation was that experiences of interdisciplinarity which we wished to analyse stemmed from widely different, if not contradictory, premises and aimed at equally different objectives. To sum this up we could

say that the experiments in interdisciplinary teaching came from either the needs or requests of students, or those of teachers and researchers, or again from demand linked to the growth process of a given science. Furthermore, these experiments tried to achieve several aims—either to improve the internal, pedagogical and scientific functioning of universities; or to make it possible for the university to adapt better to society and particularly to the needs of the labour market; or again to re-examine the intellectual partitioning between disciplines and to search for a new map of learning. It is obvious that these premises and objectives were generally connected, but when dealing with the same subjects and in combining more or less the same elements one could observe deeply different configurations.

This remark leads us on to another point: empirical analysis does not enable us to draw up any rule with regard to the combination of disciplines. Sometimes their closeness, sometimes their complementarity, sometimes even their mutual differences assist the combination of two or more disciplines. The configurations we studied seemed to vary very much depending on the historical conditions of different countries and universities, on concrete situations, and on human relationships. It is therefore very difficult to predict what the cocktail will be made of and what it will taste like. This relative confusion increases if one stops to consider the first point: that setting up a course which involves interdisciplinarity always goes along with other important changes. The changes affect the structure of the university when new departments are set up or when one observes a reduction in the autonomy of chairs or departments. Teaching methods are equally affected: early notice being taken of student feedback, group discussion, team-teaching and so on; and often one observes a very thorough re-examination of certain scientific concepts and of the status of knowledge. For instance, concepts such as the eco-system in environmental studies or the psychosomatic phenomenon in medical science are the result of interdisciplinarity and have upset the traditional thinking of zoologists or physicians.

Should we wish to sum this up we might say that the analysis of known experiments in interdisciplinary teaching shows both the very rich and fruitful character of the interdisciplinarity concept, but equally the very vagueness of it and the uneasy feeling that, because everything is related to everything else, one may do just about anything, and more particularly one can come back to a traditional partitioning of disciplines. This situation can be observed many times. In other words the interdisciplinary concept needs regulatory concepts. There are two basic problems: the first is a methodological, scientific or rather an epistemological one: what makes it right for a science to base itself on another one, or how can one build up a coherent body of knowledge with concepts coming from different fields? The second problem is institutional: what type of university structures and what type of curricula for students favour real interdisciplinary work which will not be either an haphazard mosaic of juxtaposed elements or such a global approach that it hampers all progress in knowledge? I want to make a distinction between this global approach and proper interdisciplinarity.

The two problems have been tackled by CERI since 1973. In other words we have tried to base interdisciplinarity on scientific knowledge connected with analysis of one object or a specific problem, as well as on social pressure coming from the way the university system ties in with social needs.

The analysis and clarification of concepts, plus development of models and strategies, are, of course, essential preliminaries; but it is not less vital to try to implement the findings. To this end test areas had to be considered that would be broad enough for interdisciplinarity to be studied from every aspect. They had, therefore, to include not only curriculum content and teaching methods but the structure of institutions, the objectives of courses provided, and their links with society. As early as the Nice seminar CERI chose environment and health. The publication reporting the Nice seminar described in some detail the work of two universities: one is the University of Wisconsin at Green Bay in the U.S.A., which concentrates on environment; and the other Hacettepe in Turkey, concentrating on health. Since 1970 two programmes have been initiated: one on environmental studies and one on health care systems. The purpose was to study some applications of the conclusions from the Nice seminar; to build concrete curricula, really interdisciplinary; to analyse the teaching methods and the corresponding structures; to propose a new model for institutions in higher education, i.e. problem-oriented universities; and to resolve the two previous difficulties: the epistemological problem and the institutional problem. For the environmental programme CERI organised two seminars: first in Tours in France on environmental education at university level, trends and data; the second in Hjallesvej, Denmark in June 1974. For the health programme a working group was commissioned by OECD between January 1973, and June 1974, to enquire into new directions in education for changing health care systems. During this enquiry a certain number of case studies were analysed, for instance McMaster University in Canada, Stonybrook in U.S.A., Southampton, Bobigny, etc. In September 1974, CERI initiated a fresh step in this work. In the same way that it was decided, starting from interdisciplinarity, to propose new structures and problem-orientated institutions, now, starting from this model of problem-oriented institutions, and working on existing institutions dealing with environmental and health studies, CERI decided to examine more deeply the relationships between universities and local communities. In this last programme CERI maintained the central point of interdisciplinarity but in close connection with a topic (environment, health, etc.), and in close connection with the problem of social demand. To develop this new programme we started from a description of the constitutional crises in the university in terms of the breakdown of the equilibrium between three principal university activities: teaching, research, and action in the socio-economic sector.

As well as the previous programme CERI hoped to develop simultaneously a theoretical and a practical approach. For this reason it used the following schedule. In April 1975 there took place a first meeting of a group of experts on the topic 'Is the organisation of a new type of relationship between uni-

versities and regional communities a possible solution to the conceptual crisis in the universities, including the problem of disciplines?' On 29 and 30 September a new group of experts have to analyse the concept of health and the problem of concepts. Finally, between 15 and 19 December we have a third, larger meeting to propose a model of a regional interdisciplinary problem-oriented university. This model is designed to facilitate the transition from stereotyped patterns of education to education for action, which should be connected with the community's activity in such a manner that the latest economic, scientific and social problems become those of the university. For this meeting in December, and for practical reasons, CERI chose again the health problem to build this model; but it is only a model and we want to continue in other fields.

To sum up: every year since 1969 CERI has realised more and more that interdisciplinarity is a marvellous starting point to approach the fundamental problems of the university, namely: What is knowledge? How to bring down the barriers separating disciplines? Why should higher education be the result of individual students' expectations? To resolve the community's problems; to develop research and science: how can one find an equilibrium between these functions? Third problem: How can we teach and what? The different programmes and the different models are only thoughts on the way to (full?) interdisciplinarity. To continue and complete our work we need the strict co-operation of university research and that includes, for me, listening to you.

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## DISCUSSION

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Geoffrey Squires (Nuffield Foundation): I think it very appropriate that Professor Berger was invited to open today's conference on two counts: firstly, because of the pioneering work which OECD did in this field—the OECD volume remains the most substantial piece of work that we have, to refer to; and secondly, because I have always felt that there was something vaguely continental about the term interdisciplinarity (ID) itself. That may seem a slightly frivolous remark; but it may hide what is a considerable difficulty for people in the Anglo-Saxon world, that ID thinking may involve us in habits of thought and concepts which are perhaps more familiar in continental traditions, concepts like totality and unity, which you will find frequently used in the OECD book, for example. These are the kinds of concepts which, if I may generalise horribly, people here tend to shy away from. That said, what I would like to do is to pick out a number of points from Professor Berger's paper and try to relate them to the work we have been doing here, as part of the Nuffield project on ID.

Our project focussed rather more on what might be called the practicalities: questions of how organisational and academic structures relate to ID, what ID means in terms of professional risks, how students perceive it; so that, if anything, our emphasis has been at a somewhat less theoretical level.

However, having said that, one cannot avoid the problem of definition: what are we talking about? I would agree very much with Professor Berger when he said we are talking about a spectrum or a range which may go from multi- or pluri-disciplinarity on the one hand to something so tight and so integrated that it is difficult to distinguish it from a single discipline. But the difficulty of definition goes back to the difficulty of defining disciplines in the first place. In one sense it is quite obvious what a discipline is, because a discipline will have departments, and professors, and conferences, and chairs, and so forth. However, it is very difficult to find formal agreement on definitions of disciplines. Even if you do produce common criteria you will find that they are applied unequally with respect to different disciplines, i.e. a mathematician will apply some of these criteria rather than others, and an historian will apply a different set. There are two other points that are worth raising about the concept of discipline: one is the historical element in it. People who talk about the map of knowledge sometimes forget that they are talking at this particular time. If we were talking about the map of knowledge in 1925 it would look quite different; in 1875 it looked even more different. It comes as a shock to remember how new some disciplines actually are. Modern history only became a separate school at Oxford in 1872. English is a much more recent subject; many of the Social Sciences also. The historiography of disciplines is worth bearing in mind.

The other point has to do with how far disciplines subdivide; how monolithic, how unitary they are or are not. Again I suspect that many disciplines are more divisible than we tend to think, and our perceptions are governed more than we realise by the structure of our universities and polytechnics. If we have a department which embodies or incarnates a discipline, the department is obviously a unitary thing, and therefore we tend to think that the discipline also must be a unitary thing. There is an interesting question there: if we had a different form of academic structure, if, for example, we had an institution based on course units, would this begin to affect our concept of a discipline? Would it tend to break it down, to fragment it?

With respect to this country in particular we can make a fairly clear distinction between what have traditionally been called combined degrees, or joint honours degrees, and ID work. Despite its name the conventional joint honours degree, or combined degree, is one in which two disciplines or subjects are taught in parallel or juxtaposed; but any links are fortuitous. The frontier of our concern today is where there is a deliberate attempt to teach one discipline in relation to another, and this, in fact, was the definition which we adopted for our project: two or more disciplines taught in conscious relation to one another. That is a very loose definition. It is also a statement of intention rather than result; but it does draw a useful boundary

round the area of concern. We can safely dismiss the conventional pairs like English and History, French and German, Physics and Chemistry, where there is no conscious attempt to teach either in relation to the other; but even using our loose definition there are quite a number of courses which claim to integrate or to teach two or more disciplines in relation to each other.

I have also been involved very marginally with the preparation of a degree course guide for ID courses, which has just appeared, listing roughly 170 different courses. It is a very interesting picture that comes out. One thing that is quite clear is that these courses run right across the subject spectrum. They are not confined to the Natural Sciences or the Social Sciences: one finds them everywhere. One finds them in all sorts of institutions also, and this again raises an interesting point, which Professor Eerger touched on: the relationship between academic structure and ID courses. If the structure of institutions in this country were simply the formal structure then much less ID would be possible than is the case. Many ID courses get going because people employ the informal structure. They get around the formal structure by having negotiations between departments: they set up bi-lateral treaties between a number of departments, even though the formal structure might seem to preclude this.

However, there are a number of other questions to do with the relationship between the academic structure and such courses. I do not want to go into that because I believe it will be our concern later in the day; but perhaps I could just raise one question about the compatibility of two trends at the moment. There is a considerable trend, particularly in polytechnics, towards unit or modular courses, and at the same time there is the development of ID courses. I would like to raise the question of whether these two things are in fact compatible. Perhaps the unitisation or modularisation of courses may lead to too much flexibility, too much choice, too much fragmentation with respect to ID work, which may need a rather tight cohesive structure? I offer that as a question.

Another point raised by Professor Berger which we have looked at a good deal is the effect of ID on teaching and on the profession of higher education. A number of things have appeared very sharply from our study. One is that ID work rams people together, cuts across the normal practice of privacy in teaching. It forces people very often to work in course teams, and this can be quite a dramatic experience, because it brings out into the open differences, not only of assumptions and disciplines, but of styles of teaching, and political attitudes even, which would otherwise remain muffled and perhaps not be a source of conflict. The experience of working in course teams can be very interesting and full of conflict. The other effect it may have on teaching is to push people towards greater openness, to move from the implicit or the tacit towards the explicit. If one is moving within one's traditional domain there are often enough shared assumptions to allow a great deal to be done tacitly and implicitly. Once one starts working with

people from other domains things have to be made much more explicit, because one has to develop a common language for talking about the problems of the new course. This can be a very difficult thing and may affect the nature of the course, pushing it towards greater clarity of aims and objectives. Whether that is desirable or not is another question.

Two final points: first—Professor Berger used the word 'science' several times in relation to ID. This is a difficult area, because in the first place the word 'science' may be used in different ways. It may be used rather broadly to mean any kind of organised knowledge, or rather more narrowly, to mean the natural sciences or the biological sciences or the social sciences. There is a terminological difficulty there, but in addition it is noticeable that people who discuss ID tend to skirt round the problem of the humanities, because they do not seem to fit the scheme. Though there are ID or integrated developments in the field of the humanities within this country, it is very difficult to make explicit the epistemological basis for such developments.

This leads on to the final point I would like to raise, as to why we are talking about this, why it has become a current issue. Professor Berger is right in identifying a number of different reasons, a number of different aims and rationales. Certainly the need to tackle complex social and technological problems is one, and certainly health education would seem to be a very fair example of that problem orientation, as one might call it. Then again, developments in the sciences may be another motive force behind ID work, the crossing of what are conceived to be boundary lines in the natural sciences and the life sciences. But in addition to those two motive forces behind ID developments we may come back to very vague ones: something to do with seeing things as a whole, going back to what I said at the very beginning about totality and unity. Certainly talking to students one found a general if inchoate desire 'to see things as a whole'—this phrase recurred again and again.

I also wonder if there is in ID an attempt to match our everyday phenomenological experience of the world with the structured world of organised knowledge? I would like to raise the point that one of the motives behind ID may be an attempt to achieve a certain kind of unity. I would not want to put it any more explicitly than that—to try and match the unity of the world as experienced with a unity of the world as known, as analysed, as conceived in terms of organised knowledge. I think I had better stop there. There were many other points brought up in the initial talk, but I am sure they will come up in questions.

Michael Kendall (University of London) posed the problem of university entrance requirements for ID courses. At present specialised single subject courses in higher education were reflected in similar school courses in, e.g., English sixth forms. What effect might the new courses have on the upper classes in schools?

Professor Berger (Paris, Vincennes) saw this as a really crucial difficulty, bound up with the essential concept of ID. It was not a question of someone being good in several subjects, but of underlying philosophy and ability to make connections. He could not see a simple solution.

Bernard Stonehouse (Bradford University) envisaged ID as an attempt to reverse the comparatively modern trend towards undue subject specialisation. Academic rewards had tended to go to those who were at the advancing edge of their specialisations, and this process had left significant gaps in between. Environmental problems, problems of the real world, were always ID ones, and therefore in environmental science the first steps towards solutions had to be taken by people able to cross boundaries. There were no problems teaching basic science to non-science students—in fact it was often an advantage if students had not done the normal compartmentalised school science course.

Geoffrey Squires (Nuffield Foundation) pointed out that it was by now well known that the correlation between school examination results and degree results was not nearly so high as had been commonly assumed.

Colin Flood Page (Bradford University) agreed, but emphasized the fact that the overall picture was a confused one: in some subjects in some institutions the correlation was a good one; elsewhere it might be entirely too weak.

Michael Kendall stressed that he was not thinking so much of the correlation between school and university results, but more of such questions as: 'Do you ask for particular qualifications for entry to an ID course, or do you reckon to fill all necessary gaps within the framework of the course itself, e.g. in mathematical knowledge?'

Geoffrey Squires suggested that on the whole it was the second alternative that was adopted, and he could even quote cases where, within the ID framework, students had switched their main allegiance from one side of the Arts/Science divide to the other. Nevertheless the basic problem remained and needed further attention.

John Harvey (University of East Anglia) said that in their environmental science course they worked on the principle of keeping students from all backgrounds together; but in mathematics they had been forced to give up the attempt and divide their first year into three teaching groups depending on previous achievement. This division then raised further problems when it came to the (uniform) assessment at the end of the first year.

David Jaques (London University and Hatfield Polytechnic) reinforced one of the important themes mentioned by Geoffrey Squires. Any ID course must ensure that the students were made aware of the relationship between 'objective' knowledge and their own 'subjective' experience, because this

relationship might have important consequences when it came to future action. Modular courses were often thought to be ID, but it was usually difficult to make connections between the modules, because they tended to be firmly based on existing bodies of knowledge. It was important to look for areas where boundaries might be flexible or more easily broken down—such an area might be that of innovation and collaboration in teaching techniques, e.g. in team teaching. For ID purposes it was important that staff should interact.

Rector Jorgensen (Roskilde University, Denmark) discussed the difference between the meaning of the word discipline in the more established physical sciences and the newer social sciences. The former had more rigorously formulated basic concepts and better defined boundaries, and unless the student had made a real effort to master the fundamental concepts and ideas he could not effectively transfer the knowledge available in such an area for use elsewhere. You could not escape the fact that knowledge did tend to exist within these tight, disciplinary boundaries. At Roskilde there had been a swing back to disciplinary courses, but ID was achieved via project work and student research on realistic problems.

Geoffrey Squires enlarged on the previous speaker's ideas. He saw another fundamental difficulty: the division between those who considered that discipline boundaries were a matter of culture and convention, continually changing, and those who considered that such structures closely reflected the real world and had in many cases come near to completion. He agreed with the kind of dichotomy suggested by Rector Jorgensen, but wasn't quite certain where he would place mathematics in this classification.

Professor Berger re-emphasized the point that one should not think simplistically of ID replacing the disciplines. Both were needed; but problems, situations and students were always ID. ID was not something being forced on events by teachers: it could not be avoided in the real world. The movement away from narrow disciplines was part of a contemporary current of 'de-theorisation' of science. Within this stream there was a ridiculous tendency to divide problems into 'scientific' and 'non-scientific'. Problems did not permit such a classification: it was the way of tackling them that could be either scientific or not. Psychology could be seen as a science, but when used to illumine and help teaching it was probably not altogether scientific. What exactly was a discipline? To an outsider biology might be seen as a discipline, but to a geneticist, biochemist, histologist, or anatomist, biology might appear as an ID activity. He did not see the social-science/physical-science dichotomy as the clear polarity others had described. Disciplines did change and develop; and one had to provide students with some overall ID view of the real nature of problems as well as giving them firm discipline-based knowledge.

Hans Klette (Lund University, Sweden) thought it was necessary to keep the unity of human experience clearly in mind and to recognise the historical

roots of present disciplines and values. In Western civilisation there had been a constant swing back and forth between unity and diversification, reflecting changes in social and economic conditions. At present there were pressures from governments for universities to give better value for money and from students for the provision of more meaningful courses, bringing theory and practice together, e.g. in sociology. In historic time there had been shifts in the structure of knowledge, and perhaps a major change was under way today.

**SECTION II**

**Some I.D. Courses**

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## THE STRUCTURE OF THE FOUR-YEAR DEGREE COURSES AT KEELE

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by D.G. Holloway, University of Keele

Keele was founded in 1950 and to date all graduates have followed a four year course leading to a joint honours degree in two subjects—or in International Relations (Economics, History and Politics) or P.P.E. (Philosophy, Politics and Economics).

In the first (Foundation) year all undergraduates follow a common course of lectures plus individual programmes involving five different subjects. The common lecture course, to which all departments contribute, covers the development of western civilisation, outlines the achievements of man in the Arts and the Sciences, and reviews major social and technological problems. The individual programmes provide for somewhat more detailed study of a range of subjects and every student is required to include at least one subject from each of the three main groups: humanities, social sciences and natural sciences.

During the Foundation Year undergraduates are required to write a number of essays selected from a wide-ranging list, and these must be evenly distributed across the traditional subject areas. Every undergraduate is assigned to a Discussion Group which includes about nine students and three members of staff: one each from the humanities, the social sciences and the natural sciences. Each group meets regularly to discuss general questions arising out of the common lecture course. Details of the lecture programme, the essay titles, and suggestions for Discussion Group questions are contained in a booklet published annually.\*

The Foundation Year is followed by a Principal course in which students study two subjects for three years to an honours level (Principal subjects) and a further two subjects each for one year (Subsidiary subjects). Breadth of study is still required of every undergraduate: at least one of the four subjects must be from the natural sciences (including mathematics) and one from the humanities or social sciences.

Apart from this 'broadening' requirement, there are no restrictions in principle on subject combinations and no formal course pre-requisites. Nevertheless, some combinations are barred by difficulties of time-tabling,

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\* Copies of the Prospectus and The Foundation Year Programme are available from The Registrar, University of Keele, Keele, Staffordshire, ST5 5BG.

TABLE I

|                                | 1                                            | 2                                   | 3                                         | 4                                                    | 5                                     |
|--------------------------------|----------------------------------------------|-------------------------------------|-------------------------------------------|------------------------------------------------------|---------------------------------------|
| G.C.E.<br>'A' levels           | English<br>History                           | Chemistry<br>Mathematics<br>Physics | Chemistry<br>Physics<br>Zoology           | Ancient History<br>French                            | Biology<br>Chemistry                  |
| FOUNDATION YEAR                |                                              |                                     |                                           |                                                      |                                       |
| Terminais                      | English<br>Law<br>Psychology                 | Biology<br>Mathematics<br>Physics   | English<br>Geography<br>Psychology        | American Stud.<br>Philosophy<br>Psychology           | Biology<br>Chemistry<br>Psychology    |
| Sessionals                     | American Stud.<br>Astronomy                  | Geography<br>Philosophy             | Biology<br>Law                            | Astronomy<br>Law                                     | English<br>Philosophy                 |
| PRINCIPAL YEARS                |                                              |                                     |                                           |                                                      |                                       |
| Subsidiary<br>Subjects         | Biology<br>Psychology                        | Astronomy<br>Music                  | Psychology<br>Certificate in<br>Education | Economics<br>Diploma in<br>Applied Social<br>Studies | Astronomy<br>Philosophy               |
| Principal<br>Subjects          | English<br>Politics                          | Biology<br>Chemistry                | Biology<br>English                        | Sociology<br>Social Studies                          | English<br>History                    |
| Employment<br>after graduation | Administrator<br>with the<br>British Council | Industrial<br>Scientific<br>Officer | School<br>Teacher                         | Social<br>Worker                                     | Postgraduate<br>Student in<br>English |

TABLE II

| Degree subject combination         | Percentage of students |         |
|------------------------------------|------------------------|---------|
|                                    | 1954-70                | 1971-74 |
| 2 Humanities                       | 27.6                   | 24.9    |
| 2 Social Sciences                  | 15.6                   | 21.1    |
| 2 Natural Sciences                 | 11.5                   | 7.1     |
| Humanities and Social Sci.         | 30.5                   | 31.3    |
| Humanities and Natural Sci.        | 3.0                    | 1.8     |
| Social Science and Natural Science | 11.9                   | 13.8    |

and the choice of a principal course in French, German, Maths, Physics or Chemistry is impractical without previous detailed study (e.g. A-level) or special intensive preparation during the Foundation Year.

Undergraduates on the four year course are, therefore, offered a wide choice of degree subjects at the end of their first year in the University. Over 60% change one, and 40% change both of their principal subjects from those specified in their UCCA application. Most of these changes are to 'non-school' subjects.

Table I provides examples of the courses taken by five different undergraduates at Keele and illustrates some of the ways in which the range and freedom of choice, irrespective of A-level background, have been used.

The individual principal courses offered are discrete 'packages' and with few exceptions, e.g. American Studies, International Relations, P.P.E. etc., they are in no sense inter-disciplinary. However there is ample opportunity for undergraduates to select from these 'packages' so as to cross traditional disciplines and in some subjects option courses in the final year enable students, if they wish, to develop particular inter-disciplinary topics related to both principal subjects e.g. Biochemistry or Geophysics or Philosophy of Science.

As Table II illustrates, nearly half of our undergraduates select for their degree studies principal subjects which cross the traditional divides. Although some of these inter-board combinations are fairly conventional e.g. History and Politics, Geography and Geology, Economics and Mathematics, many undergraduates choose less 'obvious' combinations, sometimes with a particular vocation in mind and sometimes from personal interest. The combinations of Economics or Philosophy or Psychology with one of the experimental sciences, and English with Law, Psychology or Sociology have recurred frequently in recent years.

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## INTERDISCIPLINARITY IN THE ENVIRONMENTAL SCIENCES

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by Dr. J. G. Harvey, University of East Anglia

By way of introduction there are three points which I wish to underline. The first of these is the distinction between an interdisciplinary degree course and an interdisciplinary component within a degree course. These are separate things; but within the environmental sciences it is possible for

both to exist. The second point is the great breadth of the environmental sciences. The natural environment extends from the upper atmosphere to the earth's interior, but the environmental sciences are being taken to include man's interaction with the environment, economic activity, and matters of this sort. Different university environmental science courses give different emphases: some emphasize the natural environment; others emphasize the biological aspects of the environment; some emphasize the built environment. In addition there are now university courses in environmental engineering, environmental studies, environmental health, environmental design, and environmental other things also. The third point that I want to underline is the one about a course having to be integrated to be interdisciplinary. It is a point that Professor Berger mentioned with regard to multidisciplinary, pluridisciplinary, interdisciplinary, or transdisciplinary courses. It is a point that Dr. Geoffrey Squires mentioned, and which is pursued in the report on Interdisciplinarity by the Group for Research and Innovation in Higher Education of the Nuffield Foundation (1975).

In something as broad as the environmental sciences it is necessary to be selective in order to achieve integration, and this selectivity provides an immediate conflict. Students appear to choose environmental science for two main reasons (amongst many others): (1) because it brings together and relates different disciplines (i.e. it is interdisciplinary); and (2) because it offers them quite a lot of choice within its boundaries. If we are going to give them the choices they want, it becomes very difficult to provide integration, because different students are exercising different choices.

I want now to go on to look at the degree course in environmental sciences at the University of East Anglia, which, in the light of what Professor Berger has said, should be described as a pluridisciplinary degree course, but within which are interdisciplinary course units. Our degree course is divided into a preliminary programme which occupies the first year, and then an honours programme extending over the second and third years.

#### PRELIMINARY PROGRAMME

In the preliminary programme we are much influenced by the wide range of backgrounds of the students who come to us. We prefer applicants to have three Advanced Level passes, including two from a list of eight science subjects, but there is no one subject which all of our students have taken at the final school leaving examinations. Our only requirement, other than university matriculation, is that they should all have Mathematics at Ordinary Level, (the examination usually taken about two years before coming up to university). What we are looking for is students with high academic ability and with motivation, and we believe that if we get students of that sort they can all cope very well with environmental sciences, regardless of the subjects in which they specialised at school. In fact we have examples of students who came to us with Advanced Level passes in

Geography, Spanish, and French, and coped extremely well with the Physics and Chemistry parts of the course, one graduating with First Class Honours in Environmental Sciences. What we aim to do therefore in the preliminary programme is to reduce the differences between our students rather than accentuate them, and also to introduce them all to a wide range of environmental sciences to help them in the choices they have to make in the honours programme. So in the first year they are all following the same course with only minor exceptions. Hence there is a real opportunity for integration of their whole programme; but the extent to which this opportunity is taken depends very much on the extent of cooperation among the teaching staff involved.\*

Some of the individual components of the Environmental Sciences preliminary programme are certainly interdisciplinary. We divide the environmental sciences into six topics, such as 'The Solid Earth' and 'The Oceans and Atmosphere'; and within some of these we are achieving a measure of interdisciplinarity. In parallel with these topics students follow a 'Methods and Techniques' course which comprises statistics, calculus, mechanics, and laboratory and field practical techniques.

#### HONOURS PROGRAMME

The honours programme is very much a course unit system. Students select six out of fourteen units, and study three in their second year and three in their third year. Somebody did work out the possible combinations of six units from fourteen and it comes out at many hundreds, despite the fact that there are some timetable restrictions. Certain groupings are often chosen; but some students take unique combinations. In one year perhaps one student taking meteorology will also be taking hydrology and geochemistry; another, oceanography and ecology; and a third, surface processes and soil science. Each of these combinations would have academic merit, but there would be little or no overlap between them. Therefore it is the student rather than the teacher who must achieve integration, if it is to occur at all. The projects undertaken by all students in the honours programme often help here. Some of the individual course units are themselves, however, interdisciplinary, focussing various disciplines on to a particular topic. Some are what I would call applied units, e.g. 'Tropical Land Resource Development', and 'Environmental Management', bringing

\*Already today there has been mention made of Open University course teams, and it is my belief that this is the kind of approach that can achieve true integration for an interdisciplinary degree course. What one finds in a conventional university situation, as has already been said, is that teaching is a very private thing and it is not easy to find out what one's colleagues are teaching, how they are teaching it, and therefore to provide the sort of integration that is necessary. It is also a much more difficult thing to teach as a member of a team, e.g. in this symposium. If one teaches in isolation from colleagues, life becomes very much easier.

together natural sciences and social sciences in order to look at the interaction between man and his environment. There are other units in which only natural sciences are employed, but several are brought to bear on some particular part of the present or past environment, e.g. 'Oceanography' and 'Environments in Time'. 'Surface Processes' was established by a geographer and a geologist together. It now has contributions from an engineer, a glaciologist, and a hydrologist. This is the sort of situation which provides an ideal opportunity for the development of interdisciplinarity.

All but one of the units at present available in the honours programme can be taken in either the second or third year. The exception is 'Environmental Management', which is only available to students in their third year. The provision of such third level courses is currently being discussed in the School. The outcome is, of course, very dependent on the availability of resources, but if these are adequate for further third level courses to be offered a fundamental question is: should such courses be exclusively interdisciplinary, like 'Environmental Management', drawing together knowledge that has been gained earlier in the degree course (and in most cases putting it into an applied context); or alternatively should they give the opportunity for further specialisation within one part of the environmental sciences? We are to some extent influenced by employment prospects. When the degree course started, seven years ago, reactions that we then got from employers indicated that they wanted specialists in some aspect of environmental science, and many of us felt at that time that this was what we must work towards, offering students the opportunity for specialisation in their final year. In fact our experience with five years of graduates has shown that, although many employers said this, and perhaps would still say it, when candidates come along with a good degree in an interdisciplinary course employers will take them on, and perhaps find that these graduates can fill the vacancies just as well as the traditional specialists.

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#### THE SCHOOL FOR INDEPENDENT STUDY AT N.E. LONDON POLYTECHNIC

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by Dr. D. H. Robbins

The School for Independent Study was established in October 1974, and at present solely operates the Diploma of Higher Education. A development unit was set up by the Polytechnic immediately after the publication of the James Committee's report, and that development unit put in proposals to the CNAA which were accepted before this last academic year. So the Poly-

technic has now had one year's experience in operating the Diploma of Higher Education Programme.

The James Committee isolated the problem that many people went into teacher training who had very little intention of becoming teachers, and therefore recommended that there should be a two-year programme of higher education which would give such people much greater vocational flexibility at the end of the two years. It recommended, roughly speaking, that the structure should consist of some academic study in specialist depth as well as some general knowledge and a general study. We therefore attempted to emphasize not just the acquisition and accumulation of knowledge, but the acquisition and accumulation of knowledge for the purpose of doing something. In devising the programme of study we attempted to start from some sort of definition of the kinds of students who would come into the programme and from what we thought to be the end point to which they would be directing themselves. We rapidly decided that our hypothetical intake of students was so generalized that we could not in advance legislate the sort of course content which would be necessary. Instead we rapidly moved to the point where, instead of ourselves as staff defining the student intake and some kind of end point to which they would be aiming, we devised a structure which would enable the students to put themselves into the intake and end-point positions so that at the very outset of the course they would attempt to define where they were, what they wanted to do, and what they wanted to get out of higher education in a period of two years.

As soon as students arrived they went through an intensive planning period which lasted for six weeks. We assigned students immediately into groups of twelve, and each group of twelve had a tutor. Each group went through the process of defining the kind of education they had had, discussing why at certain points in their school career they had chosen to do certain subjects, and why they had moved from one subject to another, and what actually was the significance of the 'A' levels they'd done, if they had done any at all. We had a high proportion of students who were in their late twenties, and many of these also took into account the kinds of work experience they had had. They often wished to devise a programme of study which was a continuation of the experiences they had had in jobs, without any reference to their previous schooling. During the six weeks, the students drew up agreements for programmes of study to last them to the end of the two years. Each agreement was signed by the tutor in charge of the group, and also by what we called a special interest tutor, and the programme of study the student was obliged to draw up divided into two parts. There was one set of activities which the student would continue to do with the other students in his group; but for half his time he was obliged to choose a special topic which would attach him to any member of staff throughout the Polytechnic, on a basis of mutual interest. We organised a situation whereby we had access to approximately 700 members of Polytechnic staff in all faculties, based on their interests as individuals, rather than their place within a department or their teaching.

To make this matter clearer I shall illustrate the range of interests in the group I had this last year. There were 11 students of whom one already had some interest in economics. Before coming on the course he had spent a year in Bangladesh on some form of voluntary aid. He initially wanted to develop his interests in the economics of the underdeveloped world, and then changed to exploring possibilities in the Polytechnic's Occupational Psychology unit. What he in fact finished up doing was a special piece of photography attempting to present visually what he saw as the mismatch between various forms of mass media presentation of events and the visual actuality of such events.

I shall just mention one or two others. Another student had spent one year in a teachers' training college before coming to us, and at that time was hoping to be a biology teacher. On coming to us he was much more concerned to use his biology differently, and he had specifically done a lot of deep sea diving and wanted to concentrate upon problems of marine ecology and of certain kinds of fish in very great detail. He was attached to a tutor in the marine biology department, and also spent half of his time within the engineering faculty pursuing the techniques of underwater technology.

These are details of some of the students, and ID is forced in two ways: (a) by having to report back individual projects to the group; and (b) by the students from their disparate backgrounds having to work out a set of projects which will actually accommodate their total range of interests. This worked successfully with my group for half of the year, but for the other half of the year we weren't able to maintain the comprehensive effort of 12 students on one project. We split into two separate group activities, partly because there was a particularly strong science and technology bunch in my group of people who found it difficult to devise project outlines which would accommodate the whole range of interests.

Two more points: first of all the problems of structure within the institution. We very definitely attempted to call ourselves 'The School for Independent Study', thereby wishing to separate ourselves from the faculty structure of the whole Polytechnic. We did not wish to be identified with any one faculty or to be a faculty. As members of staff we are drawn from various parts of the Polytechnic, but we attempt to operate as an institution which is not wholly identified with the rest of the Polytechnic, though we are all obliged to retain a teaching commitment to our original departments. We attempt to see ourselves as a structure which actually allocates students to the educational institution, and enables students to gauge the pertinence and the relevance to their problems of what institutionalized education offers, offering a deschooled context within an educational institution.

In many respects we are up against the problems of the mismatch between everyday knowledge and knowledge as defined by academic institutions. We have this problem when the students go out to the rest of the faculties in the Polytechnic. In our half of the week we are talking about the way in

which various forms of defined knowledge can be of use in dealing with certain problems within the community and around us. At the same time students find themselves up against members of staff in the faculties who feel strongly that their task is to initiate students into the whole range of a particular subject. For instance, a social psychology student in my group who wanted simply to concentrate on the effect on certain individuals of being confined in a mental asylum or borstal or any institution of that sort, found himself up against the sociology tutor who wished to initiate him into the whole range of social theory, etc. It is in cases like this that the group tutor intervenes to put the situation straight. This illustrates an important aspect of ID, which is not that we should have integration made for the student at the level of the discipline, but that the students should make their integrations on the basis of the problems which concern them, and should have a basis so that they can gauge the extent to which the disciplines can contribute to their own interests, and the solution of their problems.

We wanted to avoid the situation where we looked at paper qualifications and allowed them to influence us. We wanted to have an arbitrarily constituted group of students and to see what would be the integration that emerged from their inter-relationship. What we did was to require them to work within groups throughout the year; but we shall modify our practice in the coming year. We shall retain the whole-group emphasis on determining their educational objectives over the period of two years, and the group will then in some respects be the location where these objectives are safeguarded by the students themselves; but also we shall attempt to allow them to choose certain kinds to project activities which will move into rather less comprehensive integrations, so that there will be a group of students from the whole corpus of the intake who might well wish to focus on certain community problems, and there might be others who would wish to focus on more specialized scientific problems. Instead of enforcing the way that they should work together, as we did this year, we shall modify to some extent and make things less rigid.

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## DISCUSSION

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James Patterson (Dundee College of Technology) gave details of his college's degree in chemistry and management, organised on a sandwich basis, and making use of the student's practical experience and project work to bring out the inter-relationships between the two major aspects of the course.

Hans Klette (Lund University, Sweden) commented on the luxury of British higher education, with one teacher to twelve students—in Sweden it was usually 1 to 25 or 30. He also remarked on the fact that each student tended to make his own selection and synthesis of whatever subjects he was offered. Teachers could hardly complain about this: they had all done it themselves.

Rector Jorgensen (Roskilde University, Denmark) was concerned with Dr. Robbins' description of interdisciplinary students as 'parasites', taking what they wanted from the organisation within which they found themselves. This was certainly true of most students within his own university. How then did one train them to be independent once they had left the institution?

Dr. Robbins replied that he himself saw the staff as being in some senses themselves parasites on their sources, and he hoped that when students knew of the sources themselves, they would be encouraged to go direct to them, without any idea that some sacrosanct or privileged person was needed to make the contact. One must avoid the notion that academic knowledge was autonomous and self-indulgent, otherwise students might reject it. Its social relevance and public accountability must be kept clearly in mind.

Mr. L. F. Evans (City University, London) referred to a point made earlier by David Jaques. In a true ID course, as distinct from a multidisciplinary course, teachers shared ideas and techniques with regard to interdependent objectives, assessment procedures, expected levels of student competence, etc. Many ID courses so far described did not have such coherence, and therefore were more properly called multidisciplinary—their only ID was in the minds and choices of the students.

Harry Dunne (Lancaster University) brought to the surface what he saw as an underlying conflict in many ID courses: the conflict between the instrumental aspects of the course (the students' need to get qualifications) and the existential aspects—the teachers' desire to make students think more deeply about the fundamental aspects of the subjects being studied.

Mr. D. A. Conway (Hatfield Polytechnic) spoke of the difference between undergraduate ID courses, such as had so far been described, and postgraduate ID courses, such as his own in Operational Research. In the latter you were attempting to impose an ID pattern on people who had already had a strong disciplinary training, so that in practice they could make both a specialist and a generalist contribution.

**SECTION III**

**Planning Administration of I.D. Courses**

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## THE ADMINISTRATION OF INTERDISCIPLINARY COURSES

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by Z. C. Szkopiak, University of Surrey

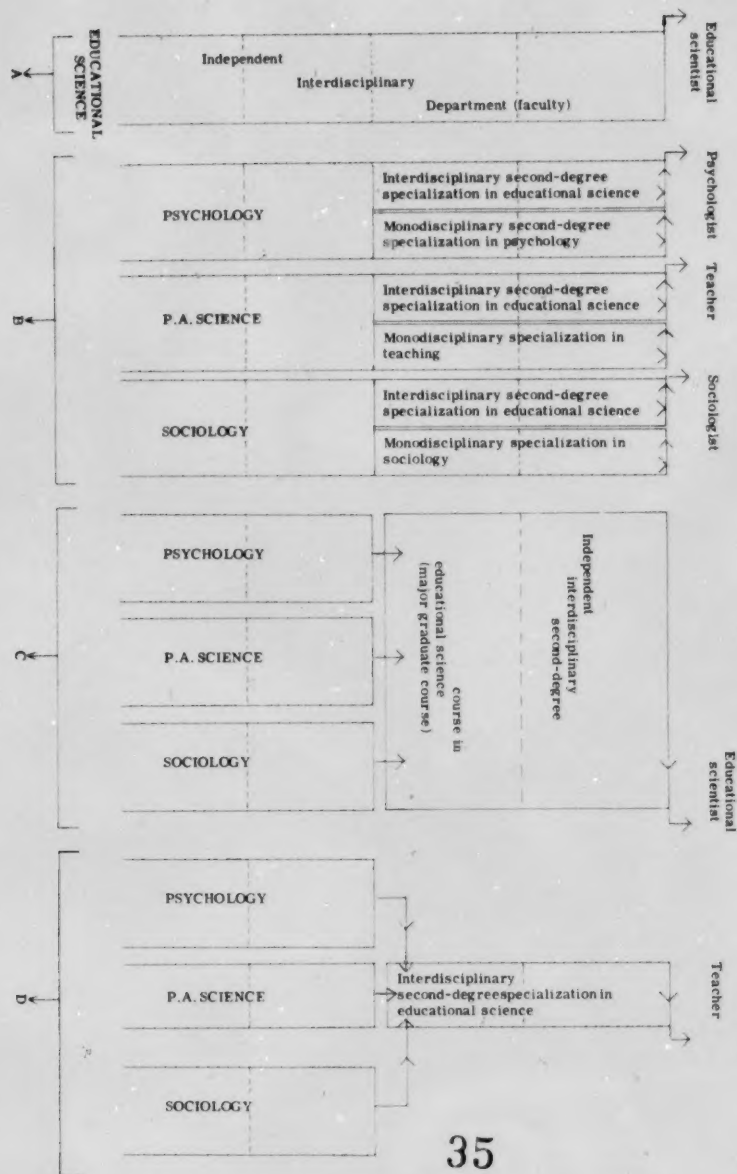
### INTRODUCTION

The administrative structure of most universities, polytechnics and colleges in Great Britain consists of departments and faculties. In such institutions interdisciplinary courses require supra-departmental administrative arrangements, which cut across departments and faculties, since bilateral treaties or agreements tend to be unstable. There appear to be two main ways in which interdisciplinary courses can be administered: one involves an administrative arrangement which is superimposed on the departmental structure, and the other is to form an entirely new department.

### STRUCTURE OF COURSES

In general interdisciplinary courses are of three types: combined, joint or modular. In general combined courses consist of 60-70% of the main or principal subject and 30-40% of the minor or contributing subject. Joint courses consist of equal parts of each subject. Modular courses consist of three or more modules which may change from year to year, and there may be two or more modules within one subject. In the case of combined and joint courses, if each of the courses is run independently there exists the possibility of complete integration of the two subjects. Such a situation is only possible if the number of students taking the course justifies a separate lecturing programme for each constituent subject of the combined or joint course. In most cases the number of students taking this type of course is too small to justify a separate lecturing programme, and the combined or joint course students take their principal subjects together with students reading for a straight degree in that subject. Furthermore, combined and/or joint course students, taking various principal subjects and a common contributing subject, will form one class in that subject. Under these conditions a complete integration between any principal subject and the contributing subject is impossible, except in specially designed projects and/or during the industrial or professional training year (at Surrey this is the third year of a four year course). Consequently these courses are not truly interdisciplinary but bi-disciplinary.

TABLE I Models for interdisciplinary courses in Educational Science (structure-models)



## ADMINISTRATIVE ARRANGEMENTS

(a) **Structure and Responsibilities:** In the case of a combined and/or joint course which is taken by a sufficient number of students to justify it being run independently there is no need for any special administrative arrangements to be made, as it can be administered by a course board of studies consisting of the lecturers who teach it. This board can be chaired by the Senior Tutor in charge of the course. Most combined and/or joint courses do not, however, fit into this category, as the number of students taking them is too small, so for administrative purposes courses with a common contributing subject have to be grouped together. This is actually the case at the University of Surrey, and I shall now outline our administrative arrangements for the combined courses in some detail.

At present the University of Surrey offers five groups of combined courses: elements of Science, Technology or Engineering can be taken with either Business Economics; or a language (French or German) and Regional Studies; or Philosophy; or Government and Administration; or Science Education. Each group of combined courses is administered by a co-ordinating committee which consists of a chairman, a course co-ordinator and two representatives from each participating department. The chairman of the co-ordinating committee for each group of courses is the Director of Combined Courses. The post of the Director is a senior University appointment with the overall responsibility for all combined, joint and modular courses offered by the University. The course co-ordinator is a member of the contributing department for each group of courses, and he or she is appointed by the head of that department. The co-ordinators are responsible for all administrative arrangements relating to their group courses.

The content of the components of a given combined course is the responsibility of the respective subject boards of studies, e.g. the Boards of Studies in Physics and in Economics are responsible for the content of the components in the combined course in Physics with Business Economics. The co-ordinating committee's responsibility is to ensure that the course content is properly balanced, so that the combined course students are not overloaded as compared with the students reading for straight degrees. The setting and marking of examinations are also the responsibility of the examination boards for the respective subjects. These boards make recommendations to the co-ordinating committees, which, after considering both sets of recommendations for a given combined course, decide whether the student proceeds with the course. In the case of final examinations the co-ordinating committee considers individual marks for each subject together with any recommendations from the respective examination boards and external examiners, and decides on the grade of the Combined Degree. In this respect the co-ordinating committees act as faculty boards and their decisions are passed to the Senate for approval and to faculty boards for information.

With respect to decisions other than those concerning examination results

the co-ordinating committees report to the Senate Committee for Combined, Joint and Modular Courses, which approves them or, in the case of decisions affecting University policy, makes recommendations to the Senate. The Director of Combined Courses is the Secretary of the Senate Committee for Combined, Joint and Modular Courses and is also an ex-officio member of the Senate and all faculty boards, so that the interests of these courses are well represented at all academic administration levels of the University.

(b) Admissions: If the admissions of applicants to an academic institution are not handled centrally, the admission of combined course applicants can be done by an admissions officer for combined course applicants, or by the admissions officers of the principal departments in collaboration with the course co-ordinator for the group of courses concerned. In the first case the admission criteria will incorporate admission criteria for both subjects, whilst in the second case the admission criteria for both subjects will be considered separately but in conjunction with one another. Applicants for combined courses are always interviewed, even if this is not an accepted practice of the participating departments. Furthermore, in the 'collaborative' procedure, the interview is carried out jointly by the admissions officer of the principal department and the course co-ordinator for the given group of combined courses. At the University of Surrey the 'collaborative' procedure for admissions has been used satisfactorily ever since the introduction of combined courses.

(c) Timetabling: There are always timetabling difficulties with courses of which parts require service teaching from other departments. These difficulties are even greater when some of the students are taking combined courses and have to be timetabled for each contributing subject. Consequently, there must be a university-wide approach to timetabling, to the extent that all departments concerned must agree on a generally acceptable system. One which has the best chance of succeeding is one which involves blocking-off certain periods (normally mornings or afternoons and/or a whole day) within which only the contributing subjects can be timetabled. In this way all combined course students in the institution can take their respective contributing subject together, whilst the straight-course students take options which are not taken by the combined course students.

### CONCLUDING REMARKS

In summarising it must be emphasised that in departmental institutions the system of administering interdisciplinary courses is primarily determined by the number of students in a given interdisciplinary course and/or for a group of given courses with a common contributing subject. Thus there appear to be available three main systems of administration:

(a) If the number of students taking a combined or a joint course is large enough, so that both subjects can be specially taught to these students, there would be no need to have a special administrative system, since this

course could be run by a board of studies, consisting of the people teaching it with the senior tutor of the course as chairman. In such cases complete integration between the two subjects is possible.

(b) If the number of students is too small for the system under (a), and combined and/or joint courses with a common contributing subject must be grouped together, there must be a senior member of staff responsible for all such courses offered by the institution. He or she can then administer these courses either

- (i) by heading an interdisciplinary department with full- or part-time supporting staff to deal with admissions, time-tabling, industrial placing (for sandwich courses), examinations and teaching arrangements for all subjects. Such a system operates at the University of Aston, Birmingham; or
- (ii) through co-ordinating committees for each group of courses in collaboration with boards of studies for principal and contributing subjects, and the Admissions Officers for participating departments. Such a system operates at the University of Surrey.

The success of the administrative system b(i) and/or b(ii) for combined and/or joint courses offered by departmental institutions of higher education depends very much on the attitude of the institution, in particular that of the chief executive officer, towards these types of courses. Since such courses are generally more demanding academically and more expensive administratively, the institution must have clear and firm policies towards them. Furthermore, individual members of staff and heads of departments must be prepared to compromise in favour of a combined or a joint course, even if this is not in the best interests of their discipline and/or department.

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#### DEVELOPMENT OF AN INTERDISCIPLINARY COURSE AT THE UNIVERSITY OF NIJMEGEN

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by J. F. M. C. Aarts and C. J. A. M. van der Linden (Nijmegen University)

Developments in the Netherlands, both at governmental level and at the level of the practice of teaching, have created the need to deal with education as a set of problems requiring an interdisciplinary approach. In order to meet this need, the Academic Council—the directing organisation for the universities—took the initiative in putting forward a proposal for an interdisciplinary course in educational science. In 1974 a committee of the Council presented a draft report exploring, amongst other things, ways in which the

interdisciplinary subject of educational science might be introduced into the university system. The Academic Council accepted this report in February 1975, but took the position that the actual organisation of ID courses should be largely determined by the local situation within the different universities.

These developments led the central administration of the University of Nijmegen to take the initiative in finding out what the possibilities were of creating an interdisciplinary course in educational science. The organisations consulted were:

- the Board of the University of Nijmegen;
- the Faculty of Social Sciences;
- the Subfaculty of Pedagogic and Andragogic Science (P.A.S.);
- the Subfaculty of Psychology; and
- the Subfaculty of Sociology.

These bodies had no difference of opinion regarding the desirability of an interdisciplinary degree course in educational science but foresaw difficulties in its organisational form and in the changes it might bring about. All shared the opinion that, should educational science be allowed to develop into an interdisciplinary department of the University of Nijmegen, independence in the organisational sense too would be desirable, for without it the development might meet with great difficulties.

During consultations on course models (see Table I) it became clear that model A could not be achieved within a short-term or middle-term period. For a long-term period, however, it was considered as probably the most satisfactory model. Models B and D were considered impracticable since they did not promote the interdisciplinary character of the educational science course. In spite of a variety of doubts, model C was taken as the template on which to work out further ideas with respect to the shaping of the interdisciplinary degree course.

The consultations between the Faculty and Subfaculties concerned and the University Board resulted in the following propositions concerning the shaping of an interdisciplinary degree course in educational science. Firstly, the existing situation did not offer the conditions necessary for an optimal development in educational science. Secondly, as regards the organisation and the content of the course in educational science, conditions would have to be created that would guarantee its interdisciplinary character and its independence, with respect to both teaching and research. Thirdly, in the Subfaculties concerned, measures would have to be taken to promote mono-disciplinary scientific research in education to make it possible thus to contribute both in the mono-disciplinary departments and in the interdisciplinary department of educational science. Fourthly, account should be taken of the fact that there already was a degree course in educational science offered by the unit of Educational Science in the Subfaculty of Pedagogic and Andragogic Science. In the fifth place, an effort had to be made to

achieve a simple structure in which duplication of facilities was avoided and in which decision-making procedures were kept as simple as possible. As a sixth point, the interdisciplinary department of educational science should be fitted into the organisational structure of the Faculty of Social Sciences in such a manner that its main structure was not affected. Finally, all this should be done with due regard to the present University statutes.

For the present, bearing in mind the propositions formulated above, the interdisciplinary course of education science is best guaranteed by structure model C. This means that the interdisciplinary course is to be established as an independent graduate course building upon a first degree ('kandidaats-examen') in either sociology, psychology or P.A.S. and leading to a second degree ('doctoraalexamen') in educational science. The curriculum will comprise, amongst other topics, subjects covering general aspects of teaching and, besides, will provide opportunities for emphasising certain aspects originating from the mono-disciplines. Within the set-up of the interdisciplinary department of educational science opportunities will be provided for interdisciplinary research in the field of teaching.

Each of the mono-disciplines, i.e. sociology, psychology and P.A.S., offers course-facilities in the area of educational science. Courses that come into consideration here are introductory parts of the undergraduate programme, seminar courses belonging to the graduate programme of the separate departments, as well as optional courses for students from other subfaculties. Within the Subfaculties of Sociology, of Psychology, and of Pedagogic and Andragogic Science, arrangements will be made to advance monodisciplinary research in the field of education.

When setting up the organisational structure, both the interdisciplinary and the mono-disciplinary aspects will have to be considered. With respect to the organisation of the teaching and the research going on in the interdisciplinary programme of educational science, it seems that a departmental unit at the level of the Faculty will best ensure the interdisciplinary character as well as the independence and ease of management of the degree course. The Faculty unit will fall under the immediate responsibility of the Faculty Board. It will work with the sub-faculties contributing to its courses.

The Faculty unit has these tasks:

- to offer tuition for the interdisciplinary course of studies in educational science;
- to engage in scientific research in the field of education, preferably in interdisciplinary studies;
- to direct and manage the interdisciplinary course of studies.

Each Subfaculty has these tasks:

- to engage in scientific research in the field of education, particularly in typically monodisciplinary research;

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- to bring contributions from its own discipline to the interdisciplinary research to be conducted within the framework of the interdisciplinary degree course in educational science;
- to offer tuition courses as parts of its own undergraduate programme, to give seminars in its own second-degree (doctoral) programme, and to provide for optional courses to be taken by students in other departments, e.g. educational sociology, educational psychology, educational methods;
- to provide tuition for the interdisciplinary main course of educational science within the framework of the interdisciplinary second-degree course in educational science.

The bodies (work-groups and subject units) in the subfaculties will be staffed by members of the scientific staff of the appropriate department. The Faculty unit will be staffed by a full-time core complemented by members of the scientific staff of the mono-disciplines on a part-time basis. These will preferably be members of staff who take part in the Subfaculties' work-groups or subject units.

The following measures will have to be taken within the University of Nijmegen:

- a. alteration of the Board Statutes;
- b. decision by the Faculty on the information of the Subfaculties' work-groups and the Faculty's unit.

Outside the University the following measures will have to be taken:

- a. decisions as regards the adaptation of the Academic Statutes;
- b. initiation of a committee working at a national level to coordinate the interdisciplinary study courses offered by the different Universities in the Netherlands.

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## DISCUSSION

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Frank Gould (Polytechnic of Central London) wanted to know how it was possible to ascertain whether ID courses were reaching the same standards as mono-disciplinary courses, and how one set about achieving such standards. How did one avoid idiosyncratic eccentricity?

Bernard Stonehouse (Bradford University) felt that so far too much had been said of the difficulties of ID work, and not enough about the possibilities. Dangers of idiosyncratic teaching were no greater in ID than in other courses. Trying to understand the relationship between subjects was possi-

bly more intellectually demanding than single subject work, however far the latter was carried. ID instigated exchange of teachers between departments, challenged expertise in the devising of new courses, and enabled established teachers to redevelop their subjects in new and refreshing contexts.

Dr. Aarts (Nijmegen University) was worried that those who were teaching in ID courses had not done enough research into them before they began and that therefore standards were not being properly maintained.

Rector Jorgensen (Roskilde University) said that it must take a certain time for a reasonable tradition of standards to be built up, but that in his university they had achieved this by allotting 50% of students' scheduled time to projects (the other 50% went to lectures and seminars). By now they felt well able to judge the students' intellectual calibre from the way in which they undertook their projects, which were carefully evaluated by a whole team of teachers.

Mr. D. A. Conway (Hatfield Polytechnic) argued that the essential ingredient in achieving proper standards in ID work was clear prior agreement by the teachers as to the nature and philosophy of the course. If an ID course was merely assembled piecemeal from disparate bits there was no guarantee of anything in the way of standards, though this kind of thing might be done to some extent in more traditional monodisciplinary courses. Standards could certainly not be compared by trying to measure acquired quanta of knowledge—ID was not concerned with the mere amassing of facts. He agreed with Dr. Aarts that careful research was one potentially important factor in the proper setting up of an ID course. A better alternative might be the clear linkage of the course with a definite set of activities outside the educational world, in the way that his own Operational Research course was based on a connected set of problems in industry, government, etc.

Hans Klette (Lund University) suggested that the ideal was constant interaction and interchange between education, research, and the world outside. He was concerned about the implications for ID work of two features of modern university life: the advent of mature students with no formal academic qualifications, and the return of older students seeking recurrent education throughout life.

Professor Berger (Paris, Vincennes) warned against too much preoccupation with standards and rigorous research when new courses were being developed. New developments could well be fruitful even if apparently not firmly based; the innovator needed an encouraging atmosphere in which to flourish. Flexibility was one of the important factors in this situation, plus the adequate provision of resources, both of men and ideas. One must avoid the tendency to judge new courses more strictly than one judged traditional ones. It was also difficult to marry traditional examinations to ID courses—the best gauge of their success was the well-carried-out project, awkward as that was to evaluate.

Michel Galais (Paris, Dauphine) had found by experience that a major stumbling block in undergraduate ID courses was to find teachers who could free themselves from their traditional limits and really think on ID lines. In recurrent education it seemed to be easier, and many teachers at this stage brought a wealth of varied and illuminating experience to their work. By legislation in France money was now available from firms for the recurrent education of their work force, and could be used to provide new ID courses geared to the workmen's needs, but many universities still offered only the traditional monodisciplinary diet.

Geoffrey Squires (Nuffield Foundation) reported that Nuffield investigations had shown that many ID courses had developed well without the need for much preliminary research or a strong theoretical base. A somewhat untidy, unplanned mode of growth appeared to be the norm in human affairs, as any cursory glance at history would show.

**SECTION IV**

**Research and Development**

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**THE SISCON PROJECT: A Personal View of an Interdisciplinary Experiment**

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by David Edge (Edinburgh University)

### HISTORICAL BACKGROUND

Some ten years ago, there was considerable talk in academic circles about the problems and possibilities of a coherent and 'rational' approach to 'Science Policy'. The rapid growth in the scale and expense of the scientific enterprises since World War II set the 'problem': its emergence as a consciously-considered topic depended on a string of events and publications, both in America and in Europe, and revealed considerable ignorance about the relationship of scientific research to economic growth, and to the attainment of 'social goals'.

Several moves were taken to attempt to remedy this perceived state of ignorance. A 'Science of Science Foundation' (since renamed the 'Science Policy Foundation') was founded in London, and embarked on a programme of seminars designed to raise interest among the influential, and to improve the level of discussion on such topics. In 1966, three academic groups were formed to pursue research and teaching in this broad area: the Science Policy Research Unit at Sussex University; the Department of Liberal Studies at Manchester University; and the Science Studies Unit at Edinburgh University. A related, concurrent development was the founding of the British Society for Social Responsibility in Science (BSSRS), with a range of (not always compatible) aims, but loosely united on the goal of raising awareness, both among scientists and the lay public, of the social determinants and political context of scientific research.

These movements and groups attracted, trained, and often retained, an assorted collection of people. They were, therefore, from the start, both politically heterogeneous and 'interdisciplinary'. The main contributing disciplines were history, philosophy, sociology (plus some social anthropology), economics, and political science—plus the educational, organisational and 'management' sciences; some legal expertise; the so-called 'policy sciences'; 'systems analysis' and operational research; 'technology assessment'; and the like. All the groups could also call on a considerable range of expertise in the natural sciences; and some groups could call on technological expertise.

Over the last ten years, these groups (and their international equivalents) have rapidly developed lines of research, and have made significant ad-

vances towards meeting their original academic goals. But they have also developed a wide range of teaching: and this development has, in Britain, led not only to new patterns of science-based university degrees, but also to more ambitious attempts at 'integrated' interdisciplinary degrees—notably in several British polytechnics. As examples of degrees which attempt a genuine measure of integration of heterogeneous disciplinary material, one might cite 'Integrated Science Studies' at the University of Aston; 'Liberal Studies in Science' at Manchester University; 'Society and Technology' at Middlesex Polytechnic; and 'Social and Physical Sciences' at Newcastle Polytechnic. Besides, in many less-integrated science degree schemes, there is a significant 'core curriculum' of 'social studies of science' material.

### THE HISTORY OF THE SISCON PROJECT

As this activity developed, the groups came into informal contact. By 1972, it had become clear that cooperation in the diffusion of new teaching materials and approaches was likely to be to the advantage of all concerned. Accordingly, an ad hoc committee drafted a scheme, and the Nuffield Foundation provided the initial finance: the 'Science in a Social Context' (SISCON) Project was born.

The SISCON Council (i.e. its formal governing body) includes representatives of nine British universities (Aston, Edinburgh, Imperial College (London), Leeds, Leicester, Manchester, Stirling, Surrey and Sussex) and three polytechnics (Middlesex, Newcastle and North-East London). However, over one hundred other institutions are 'in touch' with the Project, and receive materials regularly: 71 of these are British universities, polytechnics and colleges; 14 are in North America; 8 in Europe; 7 in Australia; and 5 elsewhere (India, South Africa, Israel and Papua-New Guinea).

The basic aim of the Project is the enrichment and development of the work of the participating institutions by the interchange of teaching experience, skills and materials. The basic tactic, which has absorbed nearly all the Project's energy and resources to date, has been the preparation, publication and circulation of 'SISCON Units'. These are collections of introductory essays; basic readings; discussion, seminar and essay topics; suggestions for further reading; explanatory notes; and so on. They 'introduce' the student to relatively-encapsulated 'topics', often problems which 'do not admit a clearcut, generally agreed answer'. The Units are circulated as drafts for trial, and 'evaluative feedback' is solicited. In some cases a separate 'Teachers' Guide' is available. As each Unit clearly states:-

'SISCON Units are not designed to be used by students in independent study. Their design assumes both direction from a teacher and the opportunity for frequent tutorial and seminar discussion. Each is intended to provide the basis for three weeks' study, taking about one third of a student's time ... The text is not intended as a complete

treatment of a topic but to guide the student into, and to link together, the readings ... The over-riding philosophy behind SISCON Units is that of encouraging student participation in the teaching/learning process, and encouraging students and teachers to engage in a continuing dialogue to guide and develop their mutual education ....'

To date, some twenty Units (some in linked pairs and trios) have been printed and distributed, and another thirty or so are at various stages of preparation. The topics can be roughly classified under five headings: 'Science and Philosophy'; 'Sociology of Science'; 'Science, Technology and Politics' (by a factor of 2, the largest category); 'Science, Technology and the Environment'; and 'Science and the Arts' (much the smallest category). The diffusion of Units into use has been relatively slow.

Besides the production of Units, the Project has also sponsored a few meetings, conferences and seminars. Relationships with schools and the CNAA are on the Project's agenda, and it may be that in the years ahead the Project's policy will shift away from the production of printed Units and towards the less tractable challenges of in-service training of teachers, cooperative evaluation of teaching experiences, and a range of 'evangelistic' and 'diplomatic' activities in which the prime focus will be the development of personal relationships.

## PROBLEMS

I do not want to give the impression, by concentrating on 'problems' that the SISCON Project cannot claim genuine 'successes'. However, it is undeniable that the Project has encountered problems. I will concentrate on these problems because I find them both interesting and revealing. If I characterise them aright, I believe that those who are interested in analysing, and in learning from, the 'interdisciplinary experience' of others, are much more likely to gain useful insights from the Project's problems than from its anticipated successes.

It seems to me that these problems have two basic sources:

- (a) substantive differences in content and approach which reflect basic tensions in the area itself;
- (b) organisational and institutional structures which would lead to inter-group differences whatever the substantive nature of the area.

(a) Basic tensions within the area: Over the past ten years, groups have adopted, essentially, one of two basic strategies in attempting to 'integrate' relevant disciplines. Briefly, these two strategies can be characterised as follows:-

- (i) to accept the 'scenario' of a 'social problem' (such as the reduction of environmental pollution, or the attainment of greater

economic benefits from investment in R & D) as defining the context and aims of the necessary interaction between relevant disciplines. Indeed, in that much of this research has been financed directly by research contracts from Government Departments, it has been indissolubly linked to the values implicit in the current political process and its institutions. This kind of 'social problem' approach might fairly be labelled 'technocratic'. It has been widely adopted, with foci, perhaps, at Sussex and Manchester.

- (ii) to define the central problem as an academic one—namely, the extent to which the content of science can be seen to be determined by 'external' social factors, and the analysis of the interaction between scientific ideas and social beliefs and concerns—and hence to conduct research which continues the already-existing traditions of the social history of science, or of 'the sociology of knowledge'. This latter tradition is itself loosely 'interdisciplinary': it encompasses themes from history, philosophy, sociology and social anthropology. Such a 'focus' is less obvious, and takes longer to develop, than does the 'social problem' approach. In Britain, it has taken deepest root in the Science Studies Unit at Edinburgh University. Their approach has influenced some other groups, and a considerable proportion of SISCON teaching is related to it. For reasons which may become obvious later this approach might fairly be labelled 'critical'.

Despite the difficulties of classifying all those involved simply in these two groups, and the fact that many claim not to find any serious tension (arguing that 'peaceful co-existence' and at least a measure of mutual cooperation is quite easily achieved) it seems to me that implicit hostility (or, at least, uncomprehending suspicion) underlies and colours much of the interaction between groups under the SISCON umbrella. Such a situation is readily explicable in terms of the nature and structure of British institutions of higher education; but it is complicated by being overlaid with a range of political commitments to which I referred earlier. The 'mapping' of political positions onto educational strategies is not a simple 'one-to-one' matter: it is not the case, for instance, that the essentially conservative (or, at least, quietly 'reformist') 'technocratic' approach attracts only those of 'right-wing' sympathies—nor is the academically radical 'critical' approach only a haven for political 'radicals'. One of the staunchest SISCON proponents of a 'systems analysis' and 'cost/benefit' approach to problems of environmental pollution is a Communist Party member; and, although the Edinburgh group can contain committed Marxists without any obvious damage to their intellectual integrity, yet, in some modish left-wing circles in and around London, that group is consistently condemned as 'irredeemably liberal'! However, although this 'cross-mapping' is not simple, and is complicated by actors' mutual perceptions, it is clear that political differences do help to compound the emotions generated by purely academic differences—and hence increase the implicit tension. Such differences have not, to date, been made explicit within the Project—although they were

briefly discussed at the final session of the 1975 Harlech Summer Conference. It is quite possible that, once they become explicit, they will prove impossible to contain—in much the same way as the analogous tension between 'radicals' and 'reformers' in BSSRS has led to serious divisions within that body.

(b) Institutional factors: Each of the active groups has developed an individuality: each (to use Bernstein's terms) has adopted its own 'integrating ideas', its own criteria of selection of topics for teaching and research, its own sense of the relevance and importance of the work of other groups, and so on. These differences are often subtle, and invisible to outsiders, but their effect can be very profound.

Let me give two examples from my personal experience. The first involved the transfer of a young Research Fellow between two 'critical' groups. After two years in the first group, the Fellow found his first few weeks in the second group unproblematic; but, after two months or so, his motivation largely vanished, he could not develop fresh work, and he 'felt lost'. And yet he had merely moved from a group in which philosophy had mainly 'called the tune', to one in which a sociological approach was dominant. This relatively small shift in disciplinary 'mix' within a 'critical' approach produced a dramatic discontinuity in academic experience.

The other example concerns the treatment of identical 'case study' material in teaching in a 'critical' group and by colleagues in a 'technocratic' group. The case study concerns the controversy over the possible siting of a nuclear power station on Cayuga Lake, in New York State. I teach this material as an example of the political impact of technical expertise, and of popular response to scientific information, linking the case to the 'sociology of scientific knowledge'. However, my 'technocratic' colleagues treat the case for its technical content: such as the problem of modelling heat flows in a deep-water lake — a technical problem whose technical resolution would lead to the preferment of a particular political option. We can sit and listen, with interest, to each other's discussion of this case: but we learn little from each other; our concerns are quite different.

Differences such as these have arisen naturally as a result of the way in which our groups came together. We have each developed our own individual approaches, which are reflected in our teaching; and the individuality is reflected in the SISCON Units themselves. The result is that, in the sense in which they were intended, it is not always easy to transfer complete Units from one already-teaching institution to another. There is clearly a reluctance to accept, and to work with, someone else's 'package deal': and yet the 'SISCON Unit' philosophy was essentially a 'package deal' idea. 'Customers' were expected to assemble courses out of a selection of basic 'building blocks', each (at least in principle) 'self-contained'. If the range of approaches between groups is so wide, and their differences so deep, then the Project may be backing (at the moment) an essentially un-

workable strategy. I am not, in fact, quite so pessimistic as I sound. Some Units are, in fact, sufficiently robust to be transferable; and there are cases of the fruitful use of 'critical' units in 'less critical' contexts. But the situation I have described is, to my mind, a fundamental problem facing the Project: it sets limits on what it can realistically accomplish.

The irony is that problems of this kind could easily have been foreseen, and this foreknowledge could have been used to make a more sensitive and (as I see it) realistic approach to the Project's overall aims. I have in mind two points here:-

(a) Many SISCON members conduct research into the processes of technological innovation. It has for some years been the accepted wisdom in this area that innovation does not come about by the transfer of 'ideas on paper', but by the transfer of people. If this is so in the relatively stable and constrained world of technological industry, how much more true would it be of innovation in the chaotic and idiosyncratic world of interdisciplinary academic teaching. But this level of reflexive self-awareness was not present in SISCON Council: indeed, one of its senior members, who pressed decisively for the production of 'building block' Units as the Project's main strategy for educational innovation, is coauthor of a standard work exposing the inadequacy of just that strategy in industry.

(b) The work of Basil Bernstein, and of others who have been applying the approach of the sociology of knowledge to educational problems, was well-known at the time the SISCON Project was born. Bernstein argues that the development of teaching on an 'integrated code' leads to the breakdown of hierarchy and of 'vertical' control. The 'integrating ideas' used are individual to each group: this leads to problems of standards of objective assessment; to difficulties of career structure, since teachers in such groups are 'not interchangeable'; and, above all, to a situation in which the ideas are not subject to external control. 'One Thousand Flowers can flourish'—and, indeed, do. My experience in the SISCON area fully bears out the strength of Bernstein's basic analysis. Each group has developed its own intellectual life: and, by and large, outsiders 'don't quite see the point'.

The 'critical' approach counsels a reflexivity, in which the analysis proffered is seen as applying with equal force to the analyst's own position. I would want to argue that the problems of the SISCON Project demonstrate the difficulties which can arise when that approach is not adopted and its advice is not taken.

#### TO RESOLVE THE DILEMMA

If the situation is as I describe it, what should be done? I can suggest three strategies:-

(a) Do nothing. Just 'let it run': let everyone 'do their own thing', and give up any attempt to formalise interchange between groups. This is not quite the counsel of despair that it may at first appear. It is still relatively early days in the academic development of the field, and many of the approaches begun in the past ten years have not yet matured. At this stage, genuine variety of academic approach is not only 'natural', but essential: to try to bring groups too close together might limit that variety unnecessarily.

Each group is publishing material arising out of its work. In a few years' time, everyone should have a much clearer idea of the individual approaches, and hence be able to select their own (or their own combination) more easily. Is it, in fact, possible to accelerate this process?

(b) To many, however, (a) is too easy. Many groups do want to meet and share experiences. It might therefore be thought important to try to establish at least the elements of a consensus, so that some exchange in depth is possible. However, it should be clear that I believe that this strategy, even if desirable, requires far more extended personal contact than has so far been attempted. Differences between groups cannot be 'talked out' in 24 hours. A far greater investment of time and (personal) effort is required. Indeed, when the extent of the necessary investment becomes clear, my guess is that most would opt for (a).

(c) The third strategy is to relate more closely to existing 'disciplinary' traditions in research in this area. We in Edinburgh consciously relate to the 'sociology of knowledge'; others have found themselves drawn more closely to 'mainstream' economics, or political sociology, or industrial sociology, or whatever. Our own experience is that this strategy need involve no real loss of the essential 'inner tension' of interdisciplinary work. But we gain a sense of academic continuity, a corpus of literature, and a wider 'audience' of active scholars with whom we have enough in common for us to 'come together and discover that we can talk the same language'. Our 'audience' is no longer parochial—confined to the handful of assorted groups who came together by historical accident ten years or so ago. And we gain the security both of a sense of 'academic depth' in our work, and of access to a range of possible career structures.

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## DISCUSSION

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In response to questions about the usefulness of SISCON Units and the extent of feedback from teachers and students as to their value and practicability

it was made clear by Kathryn Hinton (Middlesex Polytechnic) (who had recently joined David Edge's Unit) that considerable problems had arisen in their use; and that the way they had been designed and written was not necessarily the best for promoting active ID and good learning. The problems were being looked into further, but it did appear so far that the units had not done exactly what was hoped.

Tom Kitwood (Bradford University) considered that one fruitful area for promoting ID thought might be the dialogue between physical scientists and others on the values inherent in science. It was often claimed by scientists and technologists that science was value-free. To the social scientist this seemed a doubtful claim, but discussion of this fundamental issue should lead into the kind of thinking that ID required.

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## OPERATIONAL RESEARCH, INTERDISCIPLINARITY AND HIGHER EDUCATION

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by D. A. Conway, The Hatfield Polytechnic

### INTRODUCTION

This paper describes, and attempts to evaluate, the effort which has been made at The Hatfield Polytechnic over the last three years to create within a higher education institution a fully interdisciplinary activity which parallels and complements the Operational Research groups of government and industry which have, in the United Kingdom, been interdisciplinary in character ever since the first recognition of Operational Research as such.

In view of the fuzziness which attaches to the three terms in the title, I will start by describing and defining each of them, and some of their interactions, so as to build up a suitable background to the development solutions which have been tried in various institutions to the problem of creating a suitable organisation for operational research in higher education. This will include the organisation at Hatfield, which was built on a study of other organisations. In conclusion, I will derive some necessary conditions for the success of an interdisciplinary organisation such as our Centre.

### SOME DEFINITIONS AND DESCRIPTIONS

(a) Operational Research (OR): The generally-accepted British definition of Operational Research is that adopted by the OR Society and regularly printed in Operational Research Quarterly:

'Operational Research is the application of the methods of science to complex problems arising in the direction and management of large systems of men, machines, materials and money in industry, business, government, and defence. The distinctive approach is to develop a scientific model of the system, incorporating measurements of factors such as chance and risk, with which to predict and compare the outcome of alternative decisions, strategies or controls. The purpose is to help management determine its policy and actions scientifically.'

This is, however, a difficult definition to absorb quickly and has been accused of being more of a description than a definition. But the last sentence is very important: Operational Research has a clear purpose. A manager has a problem to which there is not an obvious solution, or he may suspect the obvious solution is not the best one. The manager is unlikely to have the time and may not have the background or inclination to investigate it fully and scientifically. This is where the Operational Research group becomes effective. It is worthwhile going back to the foundation of OR in order to understand the key role which interdisciplinarity has always played. Operational Research was created during the early part of World War II, within the R.A.F., because of the operating problems then being experienced with the new system of radar which was being put into operation at that time. It was obvious that the problems were not simple technical ones; and any scientists who might conceivably be useful were pressed into service, whether they were biologists, physicists or engineers.

The experience of the team suggested that it was the interaction between the concepts, ideas, and methods of the scientists from the different disciplines which produced the good non-obvious solutions to these operational problems. It was, therefore, decided to extend the experiment to other operational problems such as depth charge settings, convoy patterns and use of bomb sights, many of which are so well described by Waddington<sup>(1)</sup>.

If we jump now to the present day, what do we find in the UK? We find in industry a not dissimilar picture. Three major points are worthy of note. Firstly, there is now a much higher proportion of mathematicians in the groups, mainly because in the USA the post-war development was rather different. There OR became very much more mathematical. In Britain, however, it has never developed in practice as a branch of applied mathematics to the extent it has done in America, but has retained the commitment to interdisciplinarity in many groups. The second major difference is that there are now far more social scientists involved in the groups—they were virtually non-existent during the war. This has happened because of the growing awareness of the need for social science expertise as the problems have increasingly involved systems with a major human content.

<sup>(1)</sup>Waddington, C. H., *OR in World War II*, Elek 1977

Thus the range of the interdisciplinary activity has been considerably widened. The third major point is that you will find very few people with first degrees in OR, which hardly exist in Britain. OR is still an interdisciplinary activity in the sense that it looks, in general, for people who have graduated in a discipline and who then bring to the OR teams a specialist contribution as well as a wider contribution, and OR postgraduate education aims to build on the specialist contribution that such graduates can make. It is the interaction of disciplinary-based people which is bringing the results.

(b) Interdisciplinarity: This is a word of which I have already made considerable use. I have done so because although its real meaning tends to be fuzzy and variable, we all tend to feel comfortable with it as we all have our own meaning for it. I, however, would accept the CERI definition of it as

'... the interaction among two or more different disciplines. This interaction may range from simple communication of ideas to the mutual integration of organising concepts, methodology, procedures, epistemology, terminology, data, and organisation of research and education in a fairly large field. An interdisciplinary group consists of persons trained in different fields of knowledge (disciplines) with different concepts, methods, and data and terms organised into a common effort on a common problem with continuous intercommunication among the participants from the different disciplines.'

So I am not meaning multidisciplinary, pluridisciplinary or transdisciplinary activities. Operational Research is concerned with the interaction of several disciplines for the purpose of solving a common problem.

(c) Higher Education: In assessing the contribution which higher education has made, and is making, to Operational Research, it is important to recognise that I am looking primarily at our experience in the United Kingdom, although I am also well aware of the North American experience. Within the UK I am talking about the higher education system as embracing all those institutions that are involved in education at Higher National Diploma, Degree, Postgraduate and Research levels.

I would like to start by looking at the contribution that has been made by higher education to the general development of OR. Remember that OR started as a practical problem-solving activity, and it is the continuance of that activity which today defines OR, not any academic attempts to put boundaries to it. In general, higher education may have been detrimental to the development of OR in Britain, because it has taken what is essentially interdisciplinary activity into a discipline-based educational structure, and has in some cases distorted it badly in so doing. This distortion can be seen most clearly if we split the contribution of higher education to OR into two major segments.

- (i) The development of an applied discipline of use to OR: the major

example of this has undoubtedly been applied mathematics. Many of the developments in applied mathematics in this area have been immensely useful and we are very grateful for them. It is worth remembering, however, that some of the developments were originally made in OR and passed back to applied mathematics. Another example is the use of applied sociology and applied psychology to help with implementing solutions which involve change in organisations—here I feel that insufficient feedback has occurred from OR to the original disciplines, maybe due to the shortage of sociologists and psychologists in OR. This segment has been the major contribution of higher education to OR, probably because it is the contribution most easily made from a discipline-based institution.

(ii) The development of OR itself: i.e. the development of the interaction process to produce good solutions to the problems that OR has to solve. So far there has been relatively little work on this, as it is hard for a discipline-based academic group to understand and expedite the whole process of OR. Some work is starting in a few centres including Hatfield, but it is still far too limited in amount. It would appear that the major problem is to create an academic group which is sufficiently active interdisciplinarily to cope with the strong interdisciplinarity of OR, and this brings us to what I see to be the major problem affecting the relationship between OR and higher education: how can we organise higher education to cope with the real nature of OR or of any other interdisciplinary activity existing outside the education system?

#### ORGANISATION FOR OR IN HIGHER EDUCATION

The Hatfield Polytechnic had been interested in developing OR for several years when I joined them in 1970 after ten years in OR in industry. In 1971 it was agreed that, in view of the strength of the overlap of several departments into the field of OR, the development of OR in the Polytechnic should become the responsibility of a sub-committee of the Academic Board, comprising representatives of seven different departments; instead of making one department solely responsible. This steering committee represented the breadth of interests in OR within the Polytechnic, and had the task of developing something which, whilst overlapping with the other activities, was also distinct from them. The major initial task of the committee was to set in train the development of the part-time MSc in OR.

By Spring 1972 it was obvious that the steering committee was insufficient and that it was essential that some grouping was formed to provide the academic base for this development from the many people who were interested (about 30 in all). If at this stage we had tried to set up a separate department we would have lost virtually all thirty, because we would have created a competitive situation for their allegiance, which was mainly to

their own departments. At this stage, another colleague and I looked at the alternatives that existed elsewhere. We recognised two major groups of organisation types.

(a) An OR group is part of another department; e.g. at the University of Birmingham OR is part of the Department of Engineering Production; at the University of Bradford, OR is part of the Management Centre. What we found tended to happen was that OR tended to be regarded within the institution, and externally, as part of the monodisciplinary culture of the parent department. This happened even where the OR group developed a very considerable expertise, as had happened at Birmingham. In consequence the interdisciplinary character of OR tended to be lost, and students from institutions of this type tended to have a very specialised view of OR.

(b) An independent OR department had been set up—e.g. at the University of Lancaster, which provided the first chair in OR, and at Imperial College, London. Such an arrangement created interdisciplinarity, often of very high calibre; but a different set of problems arose. The departmental structure led to OR having boundaries set up around it which did not accord with those of the groups in industry and government. In consequence, the department tended to become isolated from the disciplines whose interaction it was supposed to be concerned with. This led either to excessive specialisation, or to introversion, and the interaction level was limited by the date of entry to the department of the latest member of staff from a particular discipline. Some departments were more successful than others at overcoming this constriction, but it did need continual watching.

What we wanted to create instead was something which allowed for the ongoing interaction of the disciplines as they existed in the Polytechnic, something which could act as the focus for the interaction of the many disciplines of which OR in industry and government was composed. The process of achieving this aim was simplified at Hatfield by the widespread acceptance of the concept that whatever department you belonged to, you could teach on courses anywhere in the Polytechnic and that they were all equally important.

The organisation which we suggested, which has become the Centre for OR Studies, involved adding a second dimension to the institutional structure. All interested members of staff could become Members or Associates of the Centre. None of them would cease to be members of their parent departments, to whom they would continue to be primarily responsible; but for the pursuit of their interest in Operational Research they would turn to the Centre for OR Studies. This is not unlike the matrix concept, but instead of having disciplines and courses as its two dimensions it would have disciplines and interdisciplinary activities. In principle everyone was treated in the same way, but in practice a small number of people, myself included, devoted themselves virtually full time to the Centre and had only loose ties with the 'parent' department.

We saw this arrangement as meeting three major defects of the other two types of organisation: it maintained the interdisciplinary dynamic of OR; it avoided undue specialisation; and it avoided any introversion. We cannot claim originality for the concept, as there was an informal precedent in the Control Group amongst the Engineering Departments; but we did span a much wider variety of departments. We also had the political advantage that we did not threaten the status of the existing departments in any way. We foresaw, and still recognise, two major problems that can occur.

Firstly the Centre can lose its effectiveness when individuals are sucked back into their parent discipline. Close liaison with the disciplines is needed to avoid this happening. Secondly the Centre is vulnerable to take-over due either to the 95% syndrome—'it is 95% Econometrics, Mathematics, Sociology, etc.', or due to withdrawal of cooperation by several discipline leaders.

What have we achieved? We have obtained CNAA approval for an interdisciplinary part-time MSc in Operational Research which involves 25 different members of staff from 8 different Academic Groups working in several teaching teams. We have got it launched in very difficult economic conditions. We are building up a varied research programme, and an external, self-financing consultancy activity. We are also building up an interesting short course and seminar programme. But—and this is one of our current problems—the more successful it is, the more it appears to threaten the status of existing groups and the tendency is for them to want to take back their part of the programme, even though it would probably kill it to do so. To be fair, this is not how they see it; but I am sure of it. It is also worth noting that the Interdisciplinary Higher Degrees Scheme at the University of Aston in Birmingham seems to be facing similar problems.

#### NECESSARY CONDITIONS FOR THE SUCCESS OF A SECOND DIMENSION ORGANISATION STRUCTURE

I will now try to draw general principles from our experience.

- (a) Some full time staff must exist and must be fully committed to the concept, otherwise the whole concept will inevitably collapse.
- (b) There must be a clear focus of interest for the interdisciplinary group. In our case this was provided by the MSc and allowed the other activities to grow up alongside it, and to some extent in consequence of it.
- (c) The interdisciplinary group must be able to offer something in return to all associated disciplines—there must be a two way interchange, so that cooperating disciplines get a clear return for their cooperation; otherwise you are dependent entirely on goodwill, and many things can cut across that. Examples of the returns we can give are:

- (i) undergraduate students attracted to courses such as Mathematics, Business Studies, Industrial Engineering by their links with OR;
- (ii) practical examples from our developing stock of case studies;
- (iii) research opportunities, such as the one we are developing on the history of OR;
- (iv) consultancy contracts.

(d) There must be close collaboration with external groups in order to maintain the parallelism and complementarity with the active problem-solving interdisciplinary groups outside the institution from whom the whole concept sprang in the first place. This could be special to OR, but I doubt it very much.

## CONCLUSIONS

It is not easy to create an interdisciplinary activity in Higher Education, but it can be done with goodwill and a willingness to change the structure. If it can be done, considerable benefit can derive to the institution. If it is not done, you are unlikely to obtain the wholehearted respect of the interdisciplinary groups outside Higher Education.

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## METHODOLOGICAL ISSUES IN EVALUATING INTERDISCIPLINARY STUDIES

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by Dr. Rolf Schulmeister, Hamburg University

Being professionally concerned with evaluating innovations in higher education, I should like to report on our experiences with interdisciplinary studies and on problems of their evaluation. Before I discuss methods of evaluation, I would like to make a few comments on the characteristic structure of the particular type of interdisciplinary studies we are dealing with, and on strategic problems of introducing interdisciplinarity into higher education.

I do not want to plunge into an attempt to define what I mean by the term interdisciplinarity. I just want to say one thing: I do not regard interdisciplinarity as a theoretical concept, but as a practical problem. Moreover, there seems to be a dangerous tendency in discussing interdisciplinarity theoretically. This task tends to absorb individuals concerned with the problem of interdisciplinarity so that they neglect reality which is full of

unsolved problems and which originally gave rise to the idea of interdisciplinarity. Instead the discussion itself is institutionalised: for example, in Centres for Interdisciplinary Synthesis, or colleges with an area of special emphasis. Most people seeking to introduce interdisciplinarity into higher education end by proposing organisational models; and the reason for this deficiency seems to be that most plans seek their justification only in their identity with epistemological principles rather than with relevant social problems. The legitimate theory or model of interdisciplinarity cannot be judged by science itself, but by its practical contributions in coping with social problems and liberating those constrained by the problems.

The usual strategy for developing interdisciplinary courses, in my view, seems to rely upon two organisational approaches, trusting either in the power of institutions to push forward innovations, or in a non-existent, normative consensus of the community of scientists. My experience, however, is that these preconditions are lacking, and that, moreover, no approach starting from the theory of science and trying to synthesise existing theories of different disciplines will ever succeed in solving social problems.

Finally, those developing interdisciplinary courses, in my view, seem to retain the old model of academic teaching: administered change, ordered innovation, fixed and detailed programmes. Here is a metaphor one of my British friends has used:

'In general, intelligent young people, or at least those possessing the appropriate educational tickets, are allowed to embark on academic tram journeys, at prescribed rates of progress to prescribed destinations according to rigidly prescribed time-tables.'

The question arises: what alternative strategy to introduce interdisciplinarity into higher education could we adopt? I suggest we should drop our basic paradigm of innovation—calling on experts, planning change from above, and in an orderly fashion. We should rely upon the explosive power of urgent social problems and of those people deprived by society and should force the process by confronting students and teachers, research and education, with these problems and those disadvantaged social groups. This strategy has been the origin of interdisciplinary activities in Germany, students joining the political actions of socially deprived groups and trying to help them with the means of science; analysing the problem, demanding theories and methods to fit needs and, in this way, learning how to study interdisciplinarity.

I shall mention three examples of this kind of interdisciplinary study which we call project-oriented-study:

- there are students of sociology, psychology, linguistics, and education trying to promote integration of foreign workers' children in school;

- there are students of different disciplines trying to develop community programs, to build up social institutions, to work with pre-school children and neglected youth in a newly constructed suburb for 40,000 inhabitants;
- there are students of chemistry, physics, biology, law, and sociology co-operating with political groups in order to prevent a huge aluminium plant from being constructed, with the assistance of the local government, in the vicinity of our city.

A British visitor to Hamburg and to the universities of Bremen and Roskilde, which are based entirely on project-oriented studies, has called this practical synthesis of disciplines, of research, education and political practice, a

'radically new approach to higher education which has been established and is developing on the Continent.

The central educational philosophy of these new approaches is that of the 'progressive' school movement. In Dewey's words, '... there is an intimate and necessary relation between the processes of actual experience and education', and the operational embodiment of this principle is project orientation.'

Having characterised the object of our research so far, it is now possible to report on the methodological issues involved in trying to evaluate this type of interdisciplinary study.

The main features of studies of this type do not fulfil the conditions of experimental situations and thus tend to bring evaluation into conflict with the basic rules of empirical social research. Project-orientation leads to a complex system of social interaction, which combines political activities, research strategies, and learning processes, a system which is not planned in advance, but gradually develops. Individuals and groups co-operating in this system do not act according to well-defined role-ascriptions, but take different roles at different times and according to collective decisions varying with the working process.

These features contradict the rules of empiricist methodology, namely: to distinguish between the researcher and the objects of research; to keep constant some of the conditions of the system while varying others and trying to eliminate interfering variables; to increase the reliability of measurement by using standardised methods and introducing rigidly presented roles. These preconditions are lacking in project-oriented studies, and this is the reason why an evaluation of these systems cannot follow the paradigm of empiricist research. The system itself does not have aims and methods defined in advance, but will find them while gradually developing itself and will change them repeatedly while learning more about itself.

The researcher trying to evaluate these processes of interaction thus has to investigate them in order to find the criteria to judge the system or to define the hypotheses of his study, because the norms and values of the system guiding the interactions are internal components of the decisions, communications, and interactions of the system itself. Investigating the process means joining the activities. The methods he will use will immediately change the pre-existing situation. Gathering data from the subjects of the system will initiate learning processes and thereby change the subjects. Demanding from them reflection about activities introduces new orientations into the system and thus structures and organises future interactions. The researcher will entirely depend on the data the subjects produce in their interactions and will only get them if the subjects are convinced that the methods of evaluation really yield useful information and do not interfere with their aims and activities.

This situation made it necessary to look for a new methodology of evaluation. In trying to develop such a methodology for evaluating project-oriented studies we fell back on Kurt Lewin's theory of action-research. Evaluation of a complex system of social interaction has predominantly two aspects:

- firstly, to observe, analyse and evaluate the system in order to find answers to such questions as: how do interdisciplinary studies emerge in project activities? What demands concerning curriculum and syllabus will emerge in coping with practical problems?
- secondly, evaluation activities are a component of the system of interaction themselves, intervening in the working-process, structuring activities while classifying them, and giving feedback to the participating subjects.

Evaluating projects is always a form of self-evaluation. Explicitly defined, the structuring effects of evaluative activities are at the same time sorts of hypotheses, rules of communication, and practical interventions. The methods of evaluation serve as media for communication between the participants. Thus a democratic co-operation of all members of project groups results—on a methodological level—in a tendency to remove or abandon the discrimination between a researcher and the objects of research. The social relation between researcher and client is, too, an epistemological relationship leading to reciprocal liberating interactions. Consequently, the legitimization of evaluation consists in the consensus between researcher and client, in collective decisions about aims and methods of evaluation, and in the contribution of research strategies to the liberation of the subjects.

In order not to come into conflict with the laws of social interaction in a project, the following rules must be observed:

1. Situations, strategies and instruments of research have to grant sufficient freedom for the activities of the project group. The group decides collectively about research problems and situations.
2. Evaluation consists of strategies and methods which not only contribute in gathering data, increasing knowledge, etc. but which actively contribute to the process of coping with the problem. Therefore they must fit into the actual working process.
3. The relationship between the purposes and the instruments of evaluation must be transparent to all participants.
4. Interventions by evaluation are only legitimate if their aims are really known to those concerned.
5. As evaluation is never the primary aim of the project group, an additional effort for purposes of evaluation must be avoided.
6. Therefore evaluation methods should be used which utilise data that are produced anyway by the working process.
7. Evaluation phases must be completed rapidly in order to allow feedback and thereby influence future interactions. An important criterion of evaluation methods therefore is the time they take.

Let me finish by telling you that I would like to have had the opportunity of illustrating this topic by giving examples of our work, especially about the project called 'cooperation between labour-unions and students and teachers of medicine, engineering and natural sciences', the aim of which is to develop curricula in the interest of the workingclass. And another point I want to mention is, I realise that I could not quite resist the criticised habit of looking for a legitimization of my practical activities by claiming their identity with epistemological principles.

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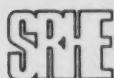
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